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TRYPANOSOMIASIS IN SOUTHERN RHODESIA.

BY

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Dr. A. G. BAGSHAWE's able paper on the "Recent Advances in our Knowledge of Sleeping Sickness," which was read before the Society of Tropical Medicine and Hygiene on the 24th January last, gave rise to a discussion which brought out some interesting facts based on the practical experience of certain of the speakers, though obviously in some cases this experience was lacking.

The appearance of trypanosomiasis in human beings in Southern Rhodesia is at present engaging the anxious attention of the Public Health Department of this territory, and certain statements were made in reference to this from which it was apparent that speakers were but indifferently acquainted with local conditions. These remarks might convey such a wrong impression that I cannot altogether let them pass. I think it would be advisable, therefore, if I gave the Society a short account of the facts which were elicited as the result of the investigations undertaken by the Administration, on the first report of the outbreak; but first it is necessary to explain the distribution of fly-belts in Southern Rhodesia.

The only variety of glossina found in Southern Rhodesia is *G. morsitans*, and its habitats are limited in area. The fly-belts, or fly-infested areas, are small in extent as compared with the country. They lie in the northern part of the territory and are widely scattered, thus differing from the distribution of the tsetse in Central and Equatorial Africa. Our knowledge of the bionomics of the fly is still too limited to supply any satisfactory explanation as to why tsetse should be confined within these somewhat arbitrary boundaries, when topographically and climatically there are stretches of country to all appearance similar, for it may be on one side of a range of hills you will find tsetse, whilst on the other side none has been known within the memory of the oldest inhabitant.



my own observations were longitudinal sections. As they demonstrate fairly clearly the general arrangement of the various important organs, a "composite" section is reproduced here. As it is self-explanatory no further description need be added.

At the conclusion of the demonstration given by Dr. LEIPER, the following remarks were made:—

Sir RONALD ROSS: I was very much interested in the little bit of history given by Dr. LEIPER regarding the discovery of the transmission of *Filaria medinensis* in Cyclops. Some years ago, when I was writing my book on "The Prevention of Malaria," I tried to burrow into the history of that discovery, and was largely helped by Dr. LEIPER at the time. It was one of the most important discoveries ever made. I must congratulate Dr. LEIPER on his large series of excellent observations. It is an important thing to find any new parasites of man, and he is finding several new ones.

Dr. F. W. O'CONNOR: I am interested in Dr. LEIPER's description of the trematode discovered by and named after Dr. YOKOGAWA. The latter has been good enough to give me the specimens just shewn.

Regarding the distribution of the trematode, it was first found in a small freshwater river fish called by the Japanese *Ai*. This fish is apparently limited to the rivers of Japan, Korea and Formosa. The fluke has the same distribution and has so far not been found in other fish. No birds have been found infected.

The Japanese have been found to be infected frequently, but not other races. This is explained by the fact that the Japanese eat the *Ai* raw, whereas the Chinese and Koreans cook the fish. The symptoms produced are those of a mild form of chronic enteritis. Large infections may occur. On one occasion, following a dose of thymol and naphtholene, 4,000 ova and mature forms were passed in the faeces.

After the outbreak of rinderpest in 1896, the fly-belts in Southern Rhodesia underwent an extraordinary shrinkage, whilst in many districts fly disappeared altogether. It must be confessed that since then fly has shewn a tendency in some places to spread back to its old boundaries, but not beyond, whilst in others fly has not reappeared at all, and this is specially noticeable on the Pungwe Flats, and the stretch of country between the Portuguese border and the coast on the east.

The scattered nature and limited extent of these fly-infested areas materially reduces the danger of any serious spread of sleeping sickness in Southern Rhodesia, and moreover renders its occurrence of secondary importance, for these areas are, in almost all instances, remote from European settlement, and are only sparsely populated by natives, who naturally eschew the country where they are debarred from keeping domestic stock. The removal of persons from any fly-infested area would therefore not be a difficult matter at any time should the necessity arise.

With reference to the appearance of trypanosomiasis in human beings in the Sebungwe Native District of Southern Rhodesia, the following information is repeated from official reports:—

The first notification of the presence of sleeping sickness or trypanosomiasis in Southern Rhodesia was received in a cable from the London Office of the British South Africa Company on August 1st, 1912, which stated that H. R. T., an official who had been stationed in the Sebungwe District, and who was then in England on sick leave, had been examined at the London School of Tropical Medicine and found to be suffering from trypanosomiasis. Enquiries were made as to this official's movements previous to leaving for England, and as it was found that he had never been north of the Zambesi, or in any known sleeping sickness area, or come in contact with tsetse fly, except in the Sebungwe area, the presumption was that he had contracted the infection there.

It was at once decided to carry out investigations in the fly area of the Sebungwe District, in order to ascertain if any cases of trypanosomiasis existed amongst the native population there, and if so, to what extent; and I was deputed, in company with Dr. F. O. STOHR (whose services were kindly lent by the Northern Rhodesia Administration for this purpose), Mr. CARBUTT (an official of the Native Department), and Mr. JACK (the Government Entomologist), to carry these out. We met

together in Sebungwe early in October and travelled through the fly area, visiting every native village and examining every individual who could be found, including men, women and children. As a result the following is a complete list of persons who were found to be infected, with particulars in each case:—

1. *H. R. T.*—Kariyangwe. Took sick March 31st, 1911. Went with Mr. J. on a shooting trip to the M'Beleli Hill, eight miles from Kariyangwe, from April 12th to 14th, 1911. Took sick with last sickness on April 23rd. Went on sick leave to England and was diagnosed in London as suffering from trypanosomiasis on August 30th, 1911. Has since died.

2. *Meleki.*—Native resident at Sibaba's kraal on the Lubu river. Has been a personal servant at Kariyangwe for some time. In March, 1911, went to visit his father at Siandola's kraal, on the Busi river. Took sick when he came back from there; was laid up about a week. Found to be suffering from trypanosomiasis by Dr. F. O. STOHR. Is now in apparently good health. Says he is quite strong and nothing the matter with him. Trypanosomes present in gland juice. An occasional trypanosome to be found in peripheral circulation. Four rabbits inoculated from this case were all negative.

3. *Shandunga.*—Native of Siandola's kraal on the Busi river. Was carrying for Dr. F. O. STOHR. Took sick at Sinasitonka's kraal, situated on a tributary of the Busi river on October 15th, 1911. Examined same day by Dr. STOHR. Trypanosomes found in peripheral circulation. He is markedly ill. Temperature rises daily to about 102° F. Complains of pains in head, back and legs. Neuralgia of the teeth. Speech slow and thick. Rabbits inoculated from this patient found infected on fifth day.

4. *Sinampamba.*—A native of Saboda's kraal, which is a sub-kraal of Gunyanka's, also on the Busi river. Sick for five months. Examined by Dr. STOHR on October 4th, and found infected with trypanosomiasis. Present condition—feels ill all over. No tremors. No oedema. A single large gland on each side of neck. Slow of speech but quite sensible. Rabbits inoculated found infected fifth day.

5. *Sinamyale.*—Native of Sianangonyi's, a sub-kraal of Gunyanka's and close to the above. Sick five months. Examined by Dr. STOHR same day as No. 4. Looks ill. Marked tremor. Speaks and acts

actively. Muscles wasted. Palpable glands side of neck, and both epitrochlea. Natives 4 and 5 went together to Ngoko's in March or April last. About ten days after returning they were both taken sick and have been sick since.

6. *Shinga*.—Native female, daughter of the Chief Sinasitonka. Lives at Lupondo's village with her husband. Lupondo's is near the Busi river, about two miles from Siandola's, and about eight miles from Sinasitonka's. Found on October 28th by self and Dr. STOHR at Sinasitonka's village, where she had been carried. Took sick in May last. Got better and took sick again in September. Patient looks very ill and anæmic, unable to walk. Temperature 102.4° F. Marked tremor. Is deaf. Deafness came on four days ago. Trypanosomes + + both in gland juice and blood.

7. *Shinga's child*.—Age about 18 months, but looks six months. Markedly anæmic. Has little shotty glands in neck. Said to have been sickly since birth. Trypanosomes + + in blood.

8. *Sinando*.—Native male, belonging also to Lupondo's kraal. Examined October 28th. Taken ill last February whilst living at Sinasitonka's. Palpable glands in neck. Trypanosomes + in glands and blood. Slight œdema of feet. Walked two miles to Sinasitonka's, here he was examined, but is not in the habit of walking so far since his illness. Before taken ill was in the habit of wandering after game and wild fruit.

9. *Ngwathla*.—Native male, belonging to Chamawa's, a sub-kraal of Gunyanka on the Busi river. Examined October 29th. Thin and muscles wasted. Looks an old man, really about 30 years. Slight œdema of feet. Temperature normal. Palpable glands both sides of neck and in both epitrochlea. Trypanosomes + + both in gland juice and peripheral circulation. Went last in July or August, 1910, to Ngoko's old kraal, and on to Bandala and Nenyunka on the Sengwe, returning *via* Manzatuba and Sinasitonka's and Siandola's to his own village. Was taken sick on the return journey and has been ill without intermission ever since. Complains chiefly of pains in his legs and inability to walk.

10. *Sianyna*.—Native male, Sibaba's village on the Lubu. Examined on November 11th. History is interesting—at beginning of dry season of this year went to Zambesi and returned *via* Ngoko's,

Sinasitonka's and Bwampu. Had no illness after this. Later was one of the carriers who took H.R.T. (case No. 1) to the railway at Malindi. Has been at his village since then. Present condition—ill and thin. A large bean and some little glands on each side of neck. On puncture trypanosomes found. Blood negative.

11. *Mwanzapegwa*.—Native male, Siabutenga's kraal, below escarpment. During dry season went to Nyika, crossing the Busi river where he found fly numerous, and was much bitten. On fourth day after returning was taken ill. Has been sick for four months. Has pains in legs and feet and cannot walk at all. Sickness began with severe headache. Has a chain of five or six glands on right side of neck, and three glands on left side. Gland puncture positive. Blood positive.

12. *Sabusa*.—Native male, of Bandala's kraal on the Sengwe. Ill nine months, since March last. Was at home hoeing his garden all the rainy season. Dr. STOHR is not prepared, however, to altogether believe this statement. Obviously ill. Walks slowly and cannot see properly. Edema of face. Seems quite intelligent. His friends say he sleeps a good deal in the day time. This is the only somnolent case seen. Gland puncture positive. Blood negative.

DISTRIBUTION OF TSETSE FLY.

Tsetse fly was encountered or reported to exist by natives over an area roughly 70 miles east and west, and 40 miles north and south, and stretching from the Nagapandi River on the west to a point some 20 miles to the east of the Sengwe River on the east, and from the Sijalila Hills on the north to the Mzola River on the south, roughly an area of 4,000 square miles.

At Kariyangwe, which was the Government station of the district, fly was reported as having been seen on several occasions, but we saw none during the time we were there. Fly was first met with at Simsau's on the Lubu River, some five miles to the east of Kariyangwe, and from there onward along the route followed it may be said to have been fairly plentiful.

The limits of the fly-belt are apparently at no time a fixed boundary, on the borders fly being met with sporadically and disappearing again.

Native evidence would appear to shew that in or about the year 1896

fly almost disappeared, but reappeared a few years later and has been spreading slowly but steadily since.

The relationship of fly to game in this area is somewhat difficult to follow, and its distribution would appear to be more influenced by geographical features than by the movement of game.

INFECTION OF STOCK.

The natives within the fly-belt have no cattle, few dogs, and only small herds of sheep and goats. Examinations of these were made, and in most cases a certain percentage were found to be infected with trypanosomiasis. Successful inoculations of rabbits were made from a human strain, a dog strain, and a goat strain, and these inoculated rabbits were forwarded to Mr. BEVAN in Salisbury. In his preliminary report Mr. BEVAN says:—

“Trypanosomes of the above strains (with one exception) correspond in motility, morphology, periods of inoculation in sub-inoculated animals, and give rise to diseases clinically identical and running almost the same course.

Appropriately stained they shew the same arrangement of granules, and in each strain trypanosomes have been encountered with nucleus in the posterior third of the parasite.

A trypanosome met with in two waterbuck shot in the infected area is indistinguishable from the above.”

AREA OF DISTRIBUTION OF TRYPANOSOMIASIS IN HUMAN BEINGS.

Though infected sheep, goats and dogs were found fairly generally distributed throughout the various villages in the fly-belt, it is a matter of interest, and probably importance, to note that almost all human beings found to be infected were either resident within, or had previous to the period of infection visited, a certain small area of country which is situated on the Busi River, a tributary of the Sengwe, the villages in this area being all under the chief Sinasitonka. The natives in these various villages are closely related by ties of marriage, and there is constant communication between the villages, and apparently little intercourse with villages in other parts of the district.

The extent of infection is small in comparison with the total native population, and this in spite of natives being freely bitten by fly in their

lands and round their villages. This is similar to conditions prevailing in the Luangwa Valley, and presumably in Nyasaland.

It seems difficult to believe that the trypanosome affecting man in this particular part of the district is the same as that found in sheep and goats in other parts of the fly area. Sheep and goats have always died between the months of November and April, after varying periods of illness, and small stock have never existed over two rainy seasons, whilst the infection of human beings, if not of recent origin, is at any rate even now extremely sporadic in nature, and the infection of man from man, or of man from goats, through the agency of tsetse fly would appear to be absent, and this in spite of the opportunities that man has of becoming infected. It may be argued that *G. morsitans* is hard to infect, but the frequent wholesale destruction of herds of small stock would presuppose a periodical heavy infection of fly. The presumption that man is hard to infect is also difficult of belief when we consider that within definite limits a relative proportion of the population is infected, but outside these limits and yet within the same fly-belt the infection of herds is common, but no infection of man has appeared.

It is possible that, in accordance with the findings of KINGHORN and YORKE, we are here dealing with a trypanosome whose reservoir is to be found in game, and whose power of transmission through the agency of fly is limited to a great extent, or what is more likely, few of the fly infected through game have the opportunity of infecting man or domestic stock, game being remote in the bush, and it is chiefly in travelling or hunting in the bush that human beings are liable to infection.

NATIVE EVIDENCE.

Native evidence both as to the distribution of fly and its infection of man is somewhat conflicting. Silubu, the paramount chief of the villages in the Lubu Valley, on being questioned said that his people were aware that the bite of the tsetse fly was in certain cases fatal to man, and that his natives feared the fly and moved about as little as possible. He further stated that most of the old people knew that the fly at one time used to kill men; not many, but a few from time to time.

This statement of Silubu's, though interesting, was not borne out by any other of the natives questioned, who all denied any knowledge of mortality in man on account of the bite of the tsetse fly.

Sinasitonka, the paramount chief in the valley of the Busi River, who is an old man, stated that previous to European occupation of the country the Southern and Eastern boundary of the fly area was unknown, as they travelled little owing to the Matabele. On the North the fly-belt stopped at the bottom of the escarpment, that is the Sijalila Hills, which is the same as to-day. There were no fly along the Zambesi, though buffalo were plentiful there. They kept sheep, goats and dogs then which did not die. Their stock commenced to die about the year 1904.

Though native evidence is interesting, at no time can it be considered reliable, and little or no faith can be attached to native statements, as in many cases they are either legendary or the result of erroneous deductions.

NATURE OF THE COUNTRY WITHIN THE FLY-BELT.

The country within the zone at present infected by *G. morsitans* is more or less mountainous and heavily timbered, but intersected by rich valleys along the main rivers and their tributaries, the formations for the most part being sandstone.

Towards Manzatuba in the north-east the country rises considerably, Manzatuba being considered about the highest point, though strangely enough it was there that tsetse fly was found to be thickest. On the Busi River and southwards as far as the Mzola River, and north-east again to the Sikomela River, lie the Matabolo Flats, which is fairly open country with patches of bush, watered by the Busi, Mzola and Sikomela Rivers and their tributaries. These flats are rich in grass and carry game in herds.

The timber and vegetation vary in different parts of the district. On the mountain ridges, and on the dry stretches away from water, it consists of deciduous trees of various sorts. On the low-lying ground it is mostly Mopani bush, whilst close to the river beds it is tropical and sub-tropical in character.

The chief problems before the Administration may be said to be :—

1. The prevention of the spread of trypanosomiasis amongst the native population of the Sebungwe district. Though after careful examination only 12 cases have been discovered, yet it cannot be assumed that these are all the cases existing, or that the disease will not continue to spread should the natives be allowed to remain within the infected area.

Fortunately we are here in a different position to either the Luangwa or Nyasaland, for in this case we have to deal only with small isolated zones infested with tsetse, and the most effective method of checking this spread is by the movement of the native population beyond the fly-infested area.

2. Following depopulation there arises the second and much more complex problem as to whether an attempt should be made to exterminate the fly, or whether the country should be turned into a large game reserve, as has been done with the fly areas in Zululand.

Our experience of the extermination of tsetse fly has so far been lacking in results, but in these cases we have been dealing with very large tracts of country, whilst in Southern Rhodesia we have the unique opportunity of experimenting with small isolated fly-belts.

At the present day the only known method by which tsetse fly has been eradicated has been by the steady advance of civilisation, the breaking up of land and general deforestation, and possibly by the consequent extermination or driving back of game. Although in an earlier part of this report I remarked that the correlation between the movement of game and the presence of tsetse is difficult, still it is an undoubted fact that within fly areas in this district where fly is thickest there game is most abundant. Though fly would not appear to follow game beyond the somewhat arbitrary boundaries of the fly-belts, yet within these fly-belts game and fly are generally associated. It is a much argued point whether fly will disappear with the disappearance of game, but in any scheme for the extermination of fly within the small fly belts of Southern Rhodesia I certainly think that the extermination or driving back of game should be included.

I am of opinion that if money can be found, more is to be gained by systematic deforestation from without inwards, by driving of roads through the country, and by breaking up large tracts of ground such as

the Matabolo Flats, and the cultivation of sugar, cotton, or other products of commercial value, and the consequent eradication of game, and the general civilisation of the country.

The total native population within the fly-belts is approximately 3,000, inclusive of men, women and children.

The conclusions arrived at may be summarised as follows:—

1. That trypanosomiasis in man undoubtedly exists in the Sebungwe district.
2. That the infection is small in relation to the population.
3. That the area of infection would appear to be limited to certain villages along the banks of the Busi river.
4. That whether we are dealing with *Trypanosoma rhodesiense* or *Trypanosoma gambiense*, or some new trypanosome, is still unproved.
5. That though fly-sickness in stock has been known for many years, infection of man would appear to be of comparatively recent origin.
6. That in order to prevent the further spread of trypanosomiasis in man within this area, or the infection of adjacent fly-belts in Southern Rhodesia, the wholesale depopulation of this fly-belt is advisable.
7. That unless steps are taken to prevent the spread of the fly, it will probably, given favourable conditions, spread beyond its present boundaries.

The above is a brief synopsis of the results of the enquiries made by the administration on the first information of the appearance of sleeping sickness in Southern Rhodesia.

The further results of examination of trypanosomes, isolated from the various strains obtained from men, goats, and dogs in this area, shew that in each case the trypanosome was identical, and is morphologically and clinically allied to the *Trypanosoma rhodesiense*. At the same time the fact that THEILER and others have found posterior nuclear forms in strains of *Trypanosoma brucei* obtained from Zululand, Egypt and Uganda, raises a doubt as to whether *Trypanosoma rhodesiense* can be classified any longer as a specific trypanosome inimical to man, transmitted by *G. morsitans*, and existing only in Northern and Southern Rhodesia and Nyasaland.

Further, Dr. TAUTE's recent bold experiments on himself with *Trypanosoma rhodesiense* obtained from game, throws considerable doubt on the specific action of this trypanosome in man.

It is not my intention here, however, to enter into any lengthy criticism as to the nature or the specificity of *Trypanosoma rhodesiense*, or of this particular trypanosome so far isolated in Southern Rhodesia, but rather to supply information as to the exact circumstances prevailing with regard to the appearance of trypanosomiasis in Southern Rhodesia.

Geographically the Sebungwe Native District is situated just south of the Zambesi river and to the east of the Bulawayo—Victoria Falls railway line, the fly-infested area being about half of the whole native district and lying to the centre.

The nearest point on the railway line to the present known western boundary of the fly belt is approximately 70 miles.

The altitude of the valleys and plateaux in this area, exclusive of hills and mountain ranges, varies from 2,300 to 3,000 feet, and the climate may be described as sub-tropical.

Concurrently with these investigations, Dr. A. J. MACKENZIE travelled through the adjacent fly-belt on the Umniati River, and examined the natives in every village there. This particular fly-belt is approximately 60 miles long by 40 miles broad, with a total population of approximately 600 natives.

No cases of trypanosomiasis in human beings were found, and only one sheep was found to be infected. This animal was sent to Salisbury for observation, and was there found to be infected with a trypanosome apparently of the Nagana type, common to stock in fly areas (BEVAN).

Dr. STOHR has since been engaged in the delimitation of the fly-belts in the north of the Lomagundi District, the results to date having proved negative as far as the infection of human beings is concerned.

These very thorough enquiries in Southern Rhodesia have elicited the fact that trypanosomiasis in human beings is so far confined to a small section of the country in the neighbourhood of the Busi and Sengwe rivers. This place is remote from European settlement, and is rarely travelled through and little known.

Almost the first hint of the occurrence of trypanosomiasis in North-Eastern Rhodesia, and as a subsequent result in Nyasaland, arose in this country by the discovery of the case of Armstrong, at Hartley, by

Dr. A. J. MACKENZIE, who sent him to me in Salisbury. This particular case was sent to England, and actually furnished the strain from which Drs. STEPHENS and FANTHAM classified the trypanosome found as *Trypanosoma rhodesiense*.

Recognition of the importance of this case was immediate, and steps were at once taken by the Administration to carry out investigations in the Luanga Valley and in North-Eastern Rhodesia, with the result that other cases were quickly found, and a large section of the country was closed to recruiting and the movement of natives. It was found impossible to effectively police such a large area, however, and natives were constantly breaking quarantine and finding their way south unauthorised and under no control. It was therefore decided to throw this area open to recruiting, and to establish a medical station at Fundu, where all natives coming south were compelled to stop, and where they are detained for a fortnight under medical observation. The result of this has been that, although some 7,000 natives passed through this station during last year, no cases of sleeping sickness have been reported as occurring on any Southern Rhodesia mines, nor amongst any northern natives working elsewhere in Southern Rhodesia.

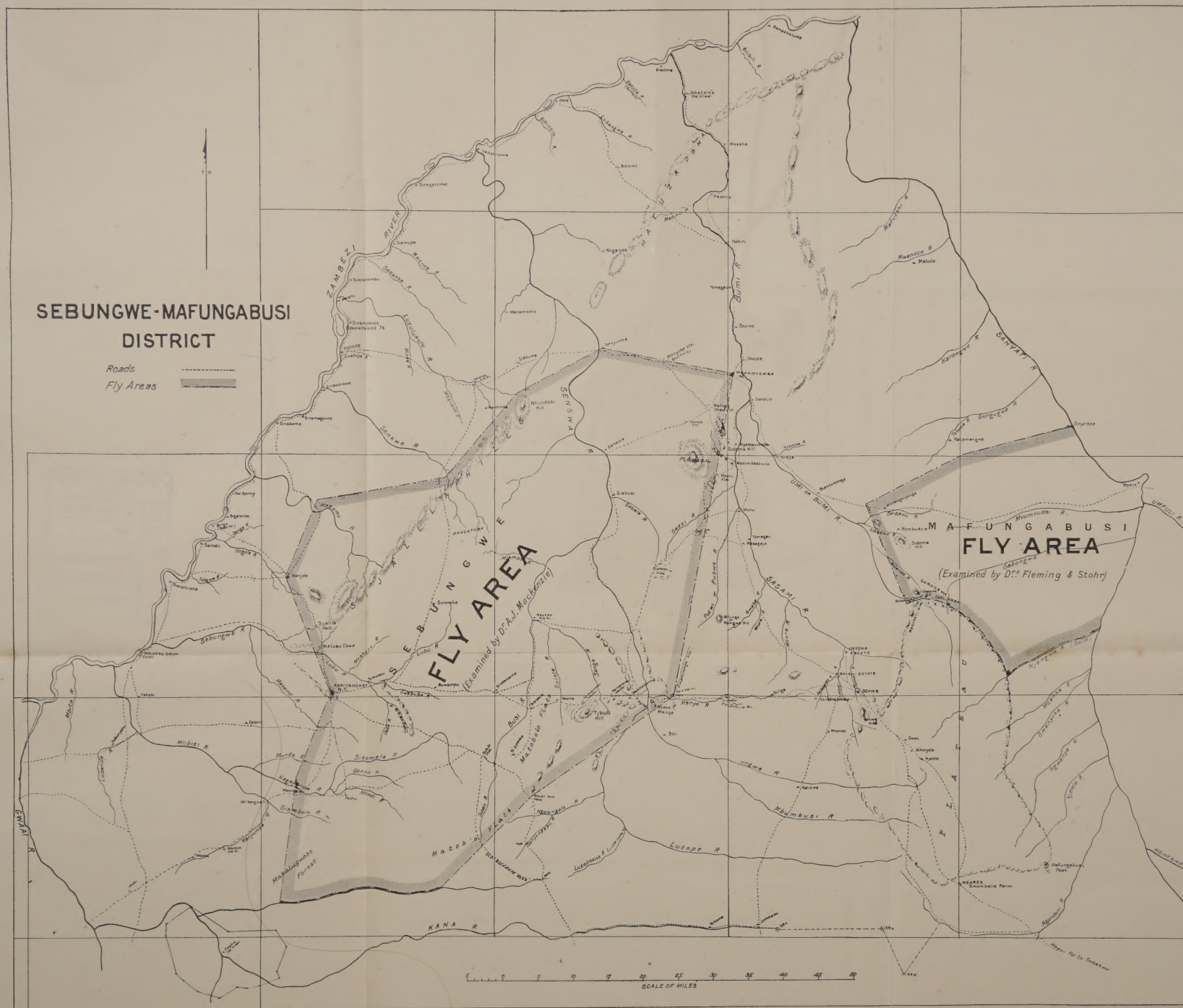
The efforts of Dr. MAY, the Principal Medical Officer of Northern Rhodesia, and his staff in this direction have apparently not been sufficiently recognised.

I would add that the cost of upkeep of this station to the British South Africa Company amounts to approximately £2,000 per annum.

The present policy, which it has been decided to adopt for the suppression of trypanosomiasis in the Sebungwe District, is briefly:—To remove all natives from this and the adjacent fly-belt on the Umniati to fly-free areas, which steps will check further local spread of the disease. As regards dealing with the fly, the eventual policy is not yet decided, but it is proposed for a start to withdraw the game laws for the area lying to the east of the Sengwe and west of the Umniati rivers, and to throw the country open for shooting. The consequent reduction of game in this area will prove a criterion as to whether in consequence of this the borders of the fly-belt can be limited, and possibly fly driven back.

This explanation is a somewhat lengthy one, but I feel strongly that an accurate statement of facts concerning the appearance of trypano-

somiasis in Southern Rhodesia, should be placed before the Fellows of the Society and others interested. I am in no way anxious to belittle the importance of this invasion, which cannot but be a source of anxiety to the local Administration, but am only desirous of placing facts in their true light, and thereby ensuring a sane and proper perspective.



MAP to illustrate Dr. A. M. FLEMING'S Paper on "Trypanosomiasis in Southern Rhodesia."

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